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ESTIMATING THE IMPACT OF
FULL VALUE ASSESSMENT ON
TAXES AND VALUE OF REAL
ESTATE IN BOSTON

Daniel Holland and Oliver Oldman

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Estimating the Impact of Full Value Assessment on Taxes and Value of Real Estate in Boston

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Introduction

While Massachusetts law requires the property tax base to be the full market value of taxable property, in fact current assessments in Boston depart considerably from this valuation.¹ Moreover, current assessments depart differentially or unequally rather than uniformly from market values, so that replacing these assessments by market values would lead to higher property taxes for some classes of properties and lower taxes for others.

In this report we will measure and evaluate the pattern of real property tax redistribution which would occur if Boston were to base its property tax on full market value rather than on current assessments. We undertook this study in the expectation that the findings might be timely since pressures were building up in the direction of full-value assessment. In fact, soon after we completed the estimates, the Massachusetts Supreme Judicial Court, in a decision handed down on December 24, 1974, mandated the full-value base for all property tax jurisdictions in the commonwealth, directing the commissioner of corporations and taxation "to take such action as will produce uniformity throughout the Common-

1. For legal references and other information, see Oldman and Aaron (1965), Black (1960), and Woodbury (1970).

wealth in valuation and assessments.”² And it is worth noting that uniformity is an issue in other states as well.

Given the judicial order to implement the full-value basis and the imminence of a shift thereto, the time is ripe for speculation on the impact of the change. Our data are rather courageous estimates that fall far short of being definitive. In our judgment, however, they are good enough to help define the broad outlines of the major areas of impacts. And we are encouraged in this assessment by the fact that two other studies, while differing importantly from each other and from our study in the proportions each major class of property constitutes of the total, do give substantially the same indications as to the major impacts.³

To help evaluate the impact of full-value assessment we have developed as of 1972 estimates of market and current assessed value of taxable properties by broad categories: residential, commercial (further subdivided into “new”—built since 1960—and “old”—built prior to 1960), and “other” (primarily vacant land). These estimates are based on fragmentary data and numerous assumptions, many of them questionable. Yet we believe that they are sufficiently accurate to suggest the orders of magnitude of the redistribution of tax liabilities attendant on changing the basis of property valuation for tax purposes.

We must emphasize that our work is far from definitive. Before the full implications of full-value assessment (or one of the alternatives discussed in the body of our report) can be understood, much more study of Boston market values is in order. Our data are good enough only for a first pass at some of the main effects that appear so broad and persuasive as to rise above the deficiencies of our estimates. Our approach,

2. *Town of Sudbury v. Commissioner of Taxation*, 321 N.E.2d 641 (Mass. 1974). The court therein declared “that (1) the commissioner [of corporations and taxation] has the power and the duty to direct local assessors to take such action as will tend to produce uniformity throughout the Commonwealth in valuation and assessments; (2) the [state tax] commission has the power and the duty to direct city and town officers to furnish such returns and statements relative to the amount and value of taxable property in the city or town as it deems necessary to enable it to determine and establish for each city and town an equalized valuation which shall be the fair cash value of all property in such city or town subject to local taxation as of January 1 in each even-numbered year; and (3) the functions of the commissioner and the commission in these respects are to command and not merely to advise or educate, and it is the legal duty of the assessors to obey their lawful commands.”

3. The other two sources for comparable estimates are: (1) estimates by the Bureau of Land Assessing of the Department of Corporations and Taxation of the Commonwealth of Massachusetts of assessed and market value of taxable property by broad categories in Boston as of the end of 1973; and (2) the 1974 Equalization Study of the Department of Corporations and Taxation of the Commonwealth of Massachusetts (unpublished) which has estimates, as of the end of 1973 of assessed and market value, by major classes of taxable property in Boston. A comparison of all three bodies of data (the two cited above and ours) appears in appendix A.

we should note, fails to come to grips with the many "practical" problems full-valuation assessment would face. For example, we have not allowed for the special case of rent-controlled property, or the possibility that Boston might, as a result of full-value assessment throughout the commonwealth experience a reduction in state aid, and so on. We stress these caveats, but we also feel that the major impacts we identify—call them tendencies if you will—are supportable despite data deficiencies. We believe, that is, that the direction and general order of the magnitudes of change are correct, but that the specific value of our estimates of any one of them could be off substantially.

Redistribution of tax and changes in property values are the foci of our study. Total revenue from the property tax in Boston is taken as given (at its 1972 level) and the changes in the shares of this total that fall on different types of property are explored. These changes are the essence of the conflict of interests whose uneasy resolution is the prime objective of tax policy. In fact the estimates in our study can be viewed as more useful for political discussion than for refined economic analysis. Estimates of the sort we have made are the raw materials from which political debate is fashioned. They belong in the political arena because they constitute the balance sheet of who would lose and who would gain on the first round. The taxpayer is keenly interested in what his new tax bill will be and what will happen to the value of his property. Answers will be sought, and, in any event, answers will be forthcoming. It is in this spirit that we offer our estimates.

Most discussions of tax redistributions portended by changes in the basis of assessment focus on the magnitudes of what we call the "initial impact." These are derived simply by an arithmetic exercise that allocates the current total tax among categories of property on the basis of their respective shares of total assessed value and then allocates the same total tax on the basis of the proportions these categories compose of total market value. A comparison of the two amounts of tax liability indicates by how much property tax would increase or decrease for each category.

Some behavioral support can be given for proceeding this way, at least as a first approximation, by arguing that assessors concerned with justifying their assessments to irate citizens or producing validating evidence in a suit in court would, under full-value assessment, set a value on the property equal to its current market value. But the estimates of tax redistributions obtained by this method necessarily would have a limited duration of relevance. For with change in property tax liabilities would come changes in market values, and with the change in market values would come still another change in tax liabilities, and so on. It is possible to treat this as a process: the "initial impact" tax change setting up a "first iteration" value change, which sets up a second tax change,

which sets up new market value, etc. An exercise along these lines appears in appendix B.

But it is quite unlikely that this infinite series of successive iterations converging on a central set of values in the limit would in fact eventuate. Assessors and investors are always searching for the determinants of value and in the process are constantly attempting to get to the heart of the matter by adjusting and capitalizing the new net income stream (net of all expenses but property tax) to arrive at an estimate of the equilibrium value. In the absence of change this estimate of the "equilibrium" value will tend to persist over time; therefore, we refer to estimates derived in this way as "steady state" estimates.⁴ In our judgment the "steady state" estimates are more relevant than the "initial impact" estimates since we think they capture the more likely result. But we remind the reader that both the "initial impact" and the "steady state" estimates embody extreme assumptions which necessarily render the estimates closer to illustrative of what *might* eventuate than predictive of what *will* happen. Our emphasis at this point is on developing techniques rather than numbers per se. At a later date when more information is available and a better basis for estimation exists, we hope to get a better handle on the numbers.

In an earlier discussion of our findings we were not properly perceptive of this point and emphasized the "initial impact" results at the expense of the "steady state" estimates (Holland and Oldman, 1974). This is unfortunate; the "initial impact" estimate is always more severe (like the first swing of a pendulum which is always more extreme than the succeeding swings), either by way of tax increase (and attendant decline in the value of property) or tax decrease (and associated rise in property value), than is the "steady state" estimate.

Now to back up a bit and explain one more designation, found in table 9.1. Column 5 in that table is labeled "first iteration." This is the value counterpart of the "initial impact" tax change estimates. In deriving it we capitalized the property's income⁵ as modified by the "initial impact" tax change.

Our primary interest at this point is to display our results and discuss their significance, to which we now proceed. The reader, however, who feels the need for a deeper understanding of our methodology should turn to appendix B and then come back to the next section.

4. It can be shown that under reasonable assumptions the "steady state" value is the same as the limiting value in the convergent series generated by the successive iterations described above.

5. More accurately, we should refer to capitalizing the income of a class of properties.

Table 9.2. Estimated Effect of Full-Value Assessment on Tax Liability of Taxable Property, Boston, 1972 (dollar amounts in millions)

Property category	Current property tax (1)	Current effective rate of tax (on market value) (2)	Property tax—"initial impact" (3)	Change in tax (4)	Percentage change in tax (5)	Effective		Property tax—"steady state" (7)	Change in tax (8)	Percentage change in tax (9)	Effective rate of tax—"steady state" (10)
						tax—"initial impact" (6)	rate of tax—"initial impact" (6)				
"New" commercial	\$ 25.77	3.7%	\$ 45.84	+\$20.07	+78%	6.6%		\$ 39.70	+\$13.93	+54%	6.6%
"Old" commercial	135.74	10.6	84.23	— 51.51	—38	6.6		99.96	— 35.78	—26	6.6
All commercial	161.51	8.2	130.07	— 31.44	—19	6.6		139.66	— 21.85	—14	6.6
Residential	134.54	5.5	161.72	+ 27.18	+20	6.6		153.43	+ 18.89	+14	6.6
Other	10.36	4.7	14.61	+ 4.25	+41	6.6		13.30	+ 2.94	+28	6.6
Total	306.40	6.6	306.40	—	—	6.6		306.40	—	—	6.6

Table 9.1. Estimated Effect of Full-Value Assessment on Market Value of Taxable Property, Boston, 1972 (in millions of dollars)

Property category	Current assessed value (1)	Proportion of total (2)	Current market value (3)	Proportion of total (4)	Market value—first iteration— (15% capitalization rate) (5)	Proportion of total (6)	Change in value (7)	Percentage change in value (8)	Market value—steady state— (15% capitalization rate) (9)	Proportion of total (10)	Change in value (11)	Percentage change in value (12)
"New" commercial	\$ 127	.0841	\$ 696	.1496	\$ 562	.1208	-\$134	-19%	\$ 603	.1296	-\$ 93	-13%
"Old" commercial	669	.4430	1,279	.2749	1,622	.3486	+ 343	+27	1,518	.3262	+ 239	+19
"All" commercial	796	.5271	1,975	.4245	2,184	.4694	+ 209	+11	2,121	.4558	+ 146	+ 7
Residential	663	.4391	2,456	.5278	2,275	.4889	- 181	- 7	2,330	.5008	- 126	- 5
Other	51	.0338	222	.0477	194	.0417	- 28	-13	202	.0434	- 20	- 9
Total	1,510	—	4,653	—	4,653	—	—	—	4,653	—	—	—

Major Findings and Their Policy Implications

The major findings and policy implications of full-value assessment on taxes and value of real estate in Boston were as follows (estimates are drawn from tables 9.1 and 9.2):

1. As of the end of 1972 the market value of taxable real property in the city of Boston was \$4,653 million (column 3 in table 9.1). Slightly more than half (53 percent) was accounted for by residential property—\$2,456 million in all. Commercial property made up most of the rest—\$1,975 million (42 percent of the total)—with other property (primarily vacant land) accounting for the remaining 5 percent (column 4).

2. While ostensibly required to assess for property tax at market value, the city of Boston (and most other local governments in the United States as well), whether by default or design, does not achieve this objective. Assessed value is lower than market value and, more important, is distributed in different proportions among categories of property than is market value. We estimate the aggregate assessed value of taxable real property at \$1,510 million (column 1 in table 9.1) and note by way of comforting comparison that our independently estimated total is close to the official figure of \$1,532 million tabulated by the city assessor's office from the tax rolls. Our concern is primarily with the proportions of this total accounted for by the various categories of property since this, in turn, determines each category's share of the property tax. As with market value, residential and commercial properties together account for all but a small percentage (3.4) of the total assessed value. But their relative importance is reversed. Residential makes up 44 percent of the tax base; commercial accounts for 53 percent.

3. Therefore, were the city of Boston to assess all taxable properties at their current full market value and raise an amount of property tax revenue equal to what was collected in 1972 (\$306.4 million), a significant redistribution of tax liabilities could be expected. Business in the aggregate would pay less, and residences would pay more. Total property tax collected from residential property would increase from \$135 to \$162 million (columns 1 and 3 in table 9.2) or by 20 percent (column 5); commercial property, on the other hand, would enjoy a decline of 19 percent (column 5) in the property tax it was responsible for, that is, a fall from \$162 million to \$130 million (columns 1 and 3). Under full market value assessment, of course, the effective rate of real property tax would be the same for all properties—6.6 percent. For residential property this would be a substantial rise over the present effective rate of 5.5 percent, while for commercial property 6.6 percent would mean a rate considerably less than the 8.2 percent currently levied on it (column 2).

4. The market values and new distribution of tax liabilities set forth in paragraphs 1, 2, and 3 above are "initial impact" results which do not take into account the effects of increases and decreases of taxes on the market values of the properties affected. To the extent that commercial property enjoys a decline in tax liability its value will rise, while to the extent that residential property suffers an increase in property tax it would command less in the market. Property values (and, along with them, of course, tax liabilities) would adjust to the initial redistribution of tax liabilities and might, in fact, adjust in anticipation thereof. Therefore, a major consequence, if not *the* major consequence, of adoption of full market value assessment can be expected to be a substantial change in the current market value of taxable properties, involving significant windfall gains and losses to present holders. Current owners of properties would enjoy or suffer these gains and losses. Through "tax capitalization" later holders would buy "free" of these tax changes.

5. The tax liabilities that would apply to different classes of property in the "steady state" are, of course, different from those that they bear now. Similar to the "initial impact" results, new commercial properties as a group, the residential property sector, and other property would all be liable for more tax than they are at present and old commercial properties for less. But the steady state tax changes would be less severe (compare columns 5 and 9 in table 9.2). Between them these two columns encompass the range of real possibilities. We may conclude, then, that as a result of assessment at full market value the residential property sector would have a tax increase on the order of 14 to 20 percent, "new" construction an even sharper rise of between 54 and 78 percent, while "old" commercial would enjoy a tax decline of 26 to 38 percent. These numbers are no more valid than the assumptions used in their derivation, so it is worth noting that had we used a capitalization rate of 10 percent rather than 15 percent (which is the more valid assumption in our opinion), the tax liability changes in the "steady state" would have been slightly less pronounced: a rise of 12 percent for residential, 47 percent for "new" commercial, and a decline of 23 percent for "old" commercial. We repeat our judgment that the "steady state" results are the more likely to obtain, not simply in the long run, but in a relatively short time. The reader is reminded, however, that the basic estimates of their fair market value of commercial properties used in this study are based on a very small sample which does not enable us to say with confidence that a more careful or thorough study might not have produced a set of fair market value estimates that would differ significantly from those that served as the basis for this entire study. The need for a careful additional original study of Boston property characteriza-

tics and their fair market value is the essential underpinning for estimates sufficiently good to be a basis for policy decisions.

6. As property tax liabilities change, the net returns available from those properties that enjoy a tax decrease would go up, and they would fetch a higher price in the market. Conversely properties subject to higher taxes would be worth less than they are now. Tax changes then will lead to changes in value. This statement borders on tautology since the value change is simply the present value of the stream of increased (or decreased) tax payments for which holders of the property are liable.

We cannot give a precise estimate of how severe the changes in value would be, but we can suggest a range that would encompass reasonable expectations as to order of magnitude. As with the possible tax change we have two "models" of the valuation process—"first iteration" and "steady state"—hence two estimates of changes in property values. The "first iteration"—the logical complement of the "initial impact" measure of tax change—takes tax change as measured by the latter and capitalizes it to arrive at a new market value. Thus this method estimates the first change in value, if the valuation process proceeded in such steps. As we have two "models" of the valuation process—"first iteration" and of an infinite series of tax-cum-market value changes that converge on the same value as the "steady state."

This latter value, however, is not to be viewed as something reached only after elapse of a considerable period of time. Rather, as already suggested, it is likely to eventuate in short order because it reflects the way assessors and investors generally would value a piece of property.

Turning to the estimates in table 9.1, we note first that the change in the value of properties would be *proportionately* less severe than the change in tax liability that caused them. Compare, for example, column 5 of table 9.2 and column 8 of table 9.1 or column 9 of table 9.2 and column 12 of table 9.1. For residential property in the aggregate, the two estimates of declines are 7 percent or 5 percent. "Old" commercial property would increase substantially in value—somewhere between 19 and 27 percent. And the decline in the value of "new" commercial property would be on the order of 13 to 19 percent.

7. These results point up two sensitive areas. Politically, the residential sector is of prime importance, for voters are renters or homeowners. Tax increases in the range of 14-20 percent are not popular with voters. Phased in over a five-year period, however, they could perhaps be tolerated. Moreover, residential property would change only moderately in value, say on the order of 5 to 7 percent. Once again, not a cause of elation in the electorate, but still moderate enough, it is hoped, to be absorbed. "New" commercial property, however, would be more severely

hit. Benefiting now from lower effective rates of tax than other major categories of property, it would suffer a tax increase of between one-half and three-quarters. And its market value would fall by 13 to 19 percent. Changes of this magnitude could make further development in Boston unattractive. Indeed, it was the presumption that this was already the case that led to the special arrangements that have moderated the property tax on "new" commercial development.

8. The findings cited to this point are based on averages for very broad classifications of property. These are the basic data of our report, but it would be unduly remiss on our part to fail to note that a wide diversity of experience for individual properties is subsumed under these averages. Thus it is trite but true that about half of the individual properties in each category would experience smaller proportionate tax increases than average, and half would have larger than average increases. In fact, the dispersions could conceivably be so large as to show a sizable number of properties having a tax increase when the average result was a decrease, and vice versa. A great many of the tax redistributions *within* categories will be larger than the redistributions, on the average, *between* categories. We have not studied this matter in any depth, but we can cite data that illustrate its importance.

9. For commercial properties we can give a sense of the within-a-category dispersion in two ways: one on the basis of averages for subgroups of commercial properties and the other on the basis of inferences about the dispersion of tax burden redistribution variation drawn from the standard deviations of the assessment-sales ratios developed in the course of our study.

10. A different burden of real property tax presently falls on "new" and "old" commercial property, as summarized in tables 9.1 and 9.2. Commercial properties built since 1960 have generally been assessed under agreement with the city at values low enough to permit earning a rate of return sufficient to induce the developers to undertake the project. As a consequence such properties—primarily office and retail—are currently bearing a tax of between 3 and 4 percent of market values. We estimate that "old" property, however, pays a tax equal to 10 to 11 percent of its market value. With full value as the tax base and all property uniformly levied on at 6.6 percent of market value, "new" commercial will have a tax increase on the order of 54 percent to 78 percent, while "old" commercial properties would enjoy a tax cut in the range of 26-38 percent (columns 5 and 9 of table 9.2).

11. But again we note that the figures show the average experience for properties in these respective categories. Within each category, a good number of individual properties would have even more startling changes in tax burden. Suggestive of this result is the high standard deviation of

Table 9.3. Frequency Array of Assessment-Sales Ratios of Properties in "Old" Commercial Sample

Value of ASR	Number of properties	Percentage of total properties
0-.10	2	1.1%
.10-.20	17	9.0
.20-.30	38	20.1
.30-.40	34	18.0
.40-.50	29	15.3
.50-.60	19	10.1
.60-.70	18	9.5
.70-.80	10	5.3
.80-.90	11	5.8
.90-1.00	1	.5
Over 1.00	10	5.3
Total	189	100.0

the assessment-sales ratios (ASRs) for "old" commercial properties. For the sample we used in developing our estimates the unweighted ASR was .47 and its standard deviation .26. What this means more particularly is brought out by the frequency array of individual ASRs for the 189 properties in the "old" commercial sample in table 9.3. Citing the "initial impact" estimates first and the "steady state" estimates in parentheses, an average "old" commercial property, that is, one currently assessed at about 52 percent of market value, would enjoy a decline in property tax of 38 (26) percent if full market value replaced current assessments as the basis of the tax. With reference to the frequency distribution, about 15 percent of properties (those in ASR class .40-.50) would, in fact, experience a decline of this order of magnitude. Thirty-seven percent (those in ASR classes .50 and above) would have a decline in tax liability proportionately greater than 38 (26) percent; some 15 percent of "old" commercial properties could well have their liability cut by 50 (33) percent or more. Similarly, about 48 percent of "old" commercial properties (those with ASRs under .40) would find their tax liability under market value assessment declining less than 38 (26) percent. In fact, those in the lowest three ASR classes (with ratios of .30 or less) would find that their property tax had gone up.

12. As for taxable residential property it is also important to recognize the wide dispersion of individual outcomes around our estimated "average" experience: an increase of 20 percent ("initial impact" estimate) or 14 percent ("steady state" estimate). While the variability around the average has not been a major concern of our study (but should be in future extensions of it) we can suggest some of the relevant orders of magnitude by drawing on some recent (as yet unpublished) work of Robert Engle.

Table 9.4. Estimated Percentage Change in Property Tax Liability under Full-Value Assessment for Residential Property in Each Boston Redevelopment Authority (BRA) Planning District, Boston, 1972 (dollar amounts in millions)

BRA planning district (1)	Percentage of total residential assessed value (2)	Estimated current tax liability ^a (3)	Percentage of total residential market value (4)	Estimated tax liability under full-value assessment ("initial impact" method) ^b (5)	Percentage change in tax lia- bility under full- value assessment ("initial im- pact" method) ^c (6)	Estimated tax liability under full-value assessment ("steady state" method) ^d (7)	Percentage change in tax liability under full-value assess- ment ("steady state") ^e (8)
East Boston	4.10%	\$ 5.5	4.16%	\$ 6.7	+ 22%	\$ 6.4	+ 16%
Charlestown	.86	1.2	1.62	2.6	+ 126	2.2	+ 83
South Boston	2.96	4.0	3.72	6.0	+ 51	5.4	+ 35
Central/North	4.61	6.2	5.67	9.2	+ 48	8.3	+ 34
Back Bay/Beacon Hill	13.54	18.2	10.58	17.1	- 6	17.4	- 4
South End	2.19	3.0	3.09	5.0	+ 70	4.4	+ 47
Fenway/Kenmore	9.35	12.6	8.41	13.6	+ 8	13.3	+ 6
Allston/Brighton	11.12	15.0	13.30	21.5	+ 44	19.5	+ 30
Jamaica Plain/Parker Hill	6.69	9.0	5.58	9.0	0	9.0	0
Washington Park/Model City	9.61	12.9	5.83	9.4	- 27	10.5	- 19
North and South Dorchester	10.83	14.6	10.12	16.4	+ 12	15.8	+ 8
Roslindale	5.72	7.7	6.58	10.6	+ 38	9.7	+ 26
West Roxbury	7.63	10.3	9.61	15.5	+ 51	13.9	+ 35
Hyde Park	5.24	7.1	6.60	10.7	+ 51	19.6	+ 35
Mattapan/Franklin	5.55	7.5	5.13	8.3	+ 11	8.1	+ 18
Total	100.00	134.5	100.00	161.7	+ 20	153.4	+ 14

Source: Unpublished estimates prepared by Robert Engle for Boston Redevelopment Authority, 1972. In the calculations we assumed that the value of tax-exempt residential property, excluded from our estimates, was distributed among BRA planning districts proportionately to the value of all residential property.

^a Column 3 = column 2 $\times$ \$134.5 million.

^b Column 5 = column 4 $\times$ \$161.7 million.

^c Column 6 = [(column 5 - column 3)/column 3] $\times$ 100.

^d Column 7 = column 4 $\times$ \$153.4 million.

^e Column 8 = [(column 7 - column 3)/column 3] $\times$ 100.

Table 9.5. Frequency Array of Estimated Percentage Changes in Residential Property Values in the Fifteen Boston Redevelopment Planning Districts

Tax change on full-value assessment	Number of planning districts ("initial impact")	Number of planning districts ("steady state")
Decline	2	2
Increase of under 10%	2	3
Increase of 10-20%	2	2
Increase of 20-30%	1	1
Increase of 30-50%	3	6
Increase of 50-100%	4	1
Increase of over 100%	1	0

Source: See Table 9.4.

He has estimated assessed values and market values of residential property for each of the fifteen planning districts by which the Boston Redevelopment Authority (BRA) divides up the city. We allocated the \$134,540,000 of property tax now levied on taxable residential properties (column 1 of table 9.2) in proportion to their share of total assessed value, then did the same but on the basis of market value for their tax burden of \$161,720,000 "initial impact" estimate (column 3) and the \$153,430,000 that would be forthcoming from taxable residential property under the "steady state" assumption (column 7). The difference between the two—current assessment tax liability and full value tax liability—is calculated as a percentage in table 9.4.

The data, procedures, and results appear in table 9.4. Among the fifteen planning districts the change in tax liability (and tax rate) would vary tremendously in importance. Under the aggregate average increase of 20 (14) percent for taxable residential properties in the city lie such disparate results as a 27 (19) percent average decrease for homes in Washington Park/Model City and a 126 (83) percent average increase for Charlestown. The changes are summarized in table 9.5.

The "steady state" estimates point to smaller changes in tax liability. Under this method, which we think the more appropriate one, five planning districts would have moderate tax increases of under 10 percent or would enjoy tax decreases; the "initial impact" method has four districts in this category. Under this latter method five districts would have property tax increases on their residential property of 50 percent or more; the "steady state" estimate is that only one district would experience a tax increase this sharp.

While property tax changes would generally be the more immediately perceived impact, residential property values, too, would change differentially among the planning districts as the existing disparities in assess-

ment-sales ratios were removed under full-value assessment. As noted in table 9.1 (column 12), residential property, in the aggregate, would decrease in value by 5 percent ("steady state" method, 15 percent capitalization rate) because of the higher property tax due from it.

But encompassed by this average is a wide diversity of results for subdivisions thereof. In table 9.6 we illustrate this for residential property arrayed by BRA planning districts, with value changes as estimated by the "steady state" assumptions with a capitalization rate of 15 percent. To cite some extremes, residential property in the Charlestown planning district would, we estimate, fall in value by 17 percent, which is more than three times the average decline, and there are five other

Table 9.6. Estimated Percentage Change in Value of Residential Property under Full-Value Assessment for Residential Property in Each BRA Planning District, Boston, 1972 ("steady state" assumption, 15 percent capitalization rate)

BRA planning district	Estimated percentage change in value
East Boston	- 6%
Charlestown	- 17
South Boston	- 10
Central/North	- 10
Back Bay/Beacon Hill	+ 2
South End	- 12
Fenway/Kenmore	- 2
Allston/Brighton	- 9
Jamaica Plain/Parker Hill	0
Washington Park/Model City	+ 11
North and South Dorchester	- 3
Roslindale	- 9
West Roxbury	- 10
Hyde Park	- 10
Mattapan/Franklin	- 3
Total residential property	- 5

Source: See table 9.4.

Table 9.7. The Diversity of Assessment-Sales Ratios for Residential Property in Boston

Type of residential property	ASR (1962)*
Single family, one structure	.341
Two family or apartments	.412
Three to five families or apartments	.520
Six or more families or apartments	.579
Multifamily, more than one structure	.650

Source: Oldman and Aaron (1965, p. 40).

* All of Boston for each type of property, excluding questionable sales.

planning districts in which the values would fall by 10 percent or more, that is, at least twice the average. On the other hand in the Washington Park/Model City district residential properties would increase in value by 11 percent.

Finally, we remind the reader that this by no means exhausts the catalog of diversity. For every one of the entries in table 9.6 is itself an average—in this case for a planning district—around which the experience of individual properties will exhibit a wide degree of dispersion.

We do not have any additional value estimates to carry the story further, but we can cite data that are strongly suggestive in this connection and tend to confirm the view that dispersions of ASRs (and hence redistributions of property tax and value changes) are greater within each category (as illustrated in tables 9.4 and 9.6) than they are between major categories (as indicated in tables 9.1 and 9.2).

13. In addition to regional variation within the city, ASRs also vary systematically by category of residential property, tending to rise with size (the number of families housed in the property) and, within a given category, tending to fall with value. If we assume in both these connections that the relative ranking of ASRs was the same in 1972 (the year we are interested in) as in 1962 (the year for which we have relevant data) we can cite evidence suggestive of the extent of dispersions in tax liability changes that would accompany full-value assessments with respect to type of residence and value.

As summarized in table 9.7 ASRs vary systematically with class of residence. Typically the smaller the residence (that is, the fewer the number of families housed in it), the lower the ASR and, therefore, the greater the expected property tax increase under full-value assessment.

Table 9.8. The Diversity of Assessment-Sales Ratios, Arrayed by Selling Price, Boston (1962)

Price range	Single family, one structure	Two families or apartments	Three to five families or apartments	Six or more families or apartments
Under \$5,000	.603	.887	.880	—
5,000-10,000	.437	.523	.606	.928
10,000-20,000	.312	.380	.478	.709
20,000-35,000	.320	.343	.387	.562
35,000-50,000	.345	.361	.419	.565
50,000-100,000	.371	.327	.369	.476
100,000-250,000	—	—	—	.548
250,000-1,000,000	—	—	—	.476

Source: Oldman and Aaron (1965, p. 44).

The average tax increase for single- and two-family houses would be the most pronounced, the tax change for apartments the most modest relatively. We lack the underlying control total necessary for estimating more precise percentage changes, so we cannot say whether the average apartment house will experience a modest tax increase or an actual decline. Since there is dispersion within any category, however, we can conjecture with some certainty that a good number of apartment houses would enjoy a decline in tax and many others a modest increase at worst, while very few single- or two-family residences could expect such an outcome.

In table 9.8 we carry the dispersion story one step further, this time with respect to price ranges within given types of residential property. The ASRs have a characteristic behavior for each category of residential property. They are highest for the least expensive properties, which suggests that these modest properties would experience a smaller average proportionate property tax increase or, in some cases, recognizing dispersion for individual properties within each price range, a more pronounced average decline in property tax, if Boston went over to market value assessments. The selling prices are as of 1962; ten years later, 1972, house prices were much higher. The classes in table 9.8, then, should be interpreted as "low," "medium," and "high" rather than as absolute numbers. Compared to the overall average, "low" price houses, as we have said, would experience a less vigorous increase than the average in tax liability under full-value assessment. "Medium" and "high" price houses, however, now relatively underassessed, would experience a higher than average tax increase. Again we note that these results are averages for each price class. With considerable additional dispersion to be expected within each class around its average, a number of "low" price homes might well enjoy a cut in taxes. For "medium" and "high" price houses this would be a less frequent result.

14. The estimates of the last several paragraphs suggest that multi-family residences, particularly apartment houses, would experience a relatively modest tax increase under full-value assessment (a not inconsiderable number of them in all likelihood might receive reductions in tax) while single-family houses in, say, the West Roxbury-Hyde Park area would be subject to sharply increased burdens. The existing dispersion of effective rates may reflect quite closely, by broad classes of property and regions of the city, the political effectiveness of taxpayers and their attitude toward the property tax. If tenants as a whole do not think they bear much of the property tax and have no particular sympathy for relieving the tax burden on landlords and if some of the recent speculation about the incidence of the property tax is correct in stating

that the tenants are at least in part right in their intuition, then the case for a substantial reduction in the burdens on apartment houses may be difficult to make.⁶ Conversely, the owners of single-family homes in the West Roxbury-Hyde Park area constitute an important group of voters who would be reluctant to lose the benefit from the city's practice of only rarely raising assessments even in areas of rising property values and who are not particularly concerned that other taxpayers not so favorably situated bear the burdens not borne by West Roxbury-Hyde Park.

15. If one looks at the city public as a whole, from the point of view of who gains and who loses, an important advantage of going to 100 percent valuation is public awareness of the policy and the possible assistance of the public in policing it. At present the lack of public awareness of assessment policy or of changes in it makes it easy for the city to engage in one or another kind of tax deal. The situation is ripe for abuse and the entrenchment of existing differentials and distortions. One device that may be found useful to the city to assist in the policing of the 100 percent valuation policy (or any other publicly announced, legal policy) is the one used in Wisconsin, perhaps in some other states, and in New Zealand. Under this device a statute would enable two or three taxpayers to petition the local administration (and if no action is taken there, the State Tax Commission) to revalue a property which the petitioners think is underassessed. Since assessment records are public already, the comparisons of assessments by taxpayers would provide a useful general check which would identify flagrant underassessment.

16. While group averages, then, by no means tell the whole of the story, they are sufficient data for suggesting that there may well be political obstacles in the way of complete and immediate implementation of the legally required full-value assessment. The discussion of the next several paragraphs is based, for convenience, on the "initial impact" estimates of tax liability change. While they tend to overstate the amount of tax change, we are interested here primarily in the relative picture for the different major property categories and the direction of change in relative burden attendant upon one or another modification of uniform full-value assessment. And these general points are not affected by the upward bias of the "initial impact" estimates vis-a-vis those based on the "steady state" assumption.

An average increase in property tax on residences of 20 percent, an average decline of property tax of 38 percent for "old" commercial properties, and an average rise of 78 percent for "new" commercial

6. For surveys of references to literature on recent property tax incidence studies, see Ladd (1973) and Netzer (1973).

Table 9.9. Percentage Difference in Property Tax Burden of Specified Categories of Real Property under Six Alternative Bases Compared with Current Tax, Boston, 1972 ("initial impact" estimates)

Category	Market value	New commercial freeze	50% adjustment new commercial	50% adjustment all property	50% adjustment residential	Residential freeze
All commercial						
New	+ 78	0	+ 39	+ 59	+ 95	+ 111
Old	-38	-33	-36	-29	-32	- 26
Total	-19	-28	-24	-15	-12	- 4
Residential	+ 20	+ 29	+ 25	+ 15	+ 10	0
Other	+ 41	+ 52	+ 47	+ 31	+ 54	+ 68
All taxable property	0	0	0	0	0	0

properties may simply be too severe a change to be implemented in full. Moreover, it could be that even if the political will to effectuate such a change existed, the moral force behind agreements made by the city with property owners may preclude instantaneous and complete application of full valuation to "new" commercial properties, even though the agreements may be without legal force. In recognition of these considerations, we have analyzed the redistributive consequences of five alternative courses of action between doing nothing and going to 100 percent valuation for all. The estimates on which our discussion is based appear in table 9.9.

17. If it should turn out that the city of Boston is, in effect, committed by its contractual arrangements to a "freeze" on "new" commercial property, the portion of the total property tax load borne by other categories of property would, perforce, be higher than if the "new" commercial were also to be assessed at full value. Residential property would, on the average, bear a tax 29 percent higher than at present rather than 20 percent higher, while "old" commercial properties would experience a more modest decline, albeit of about one-third, compared to the 38 percent decline under full-value assessment for all properties. Obviously, a mayor caught between a judicial directive to tax uniformly at full market value and a "new" commercial "freeze" would be in the unenviable position of having to adjust property tax liabilities so homeowners and renters (all voters) experienced an average rise of 29 percent in their property tax, while the property tax of "new" commercial properties was unchanged, and the load on "old" commercial properties fell by a third.

18. Under such pressure the mayor might well decide (if the law gave him some scope) that while he would have to show special solicitude for

those properties with tax compacts, he could not afford not to raise somewhat the tax due from them. He might, for example, as regards "new" commercial property make half of the adjustment called for by the principle of full-value assessment. Our estimates suggest, however, that there is not much political nourishment in such a policy. It is true that homeowners would have a smaller tax increase than under the "new" commercial "freeze," but an average increase of 25 percent over present levels could still be considered "crushing." Moreover, if it is true that the compacts were necessary at the margin of choice to get new development to locate in Boston and not elsewhere, a 39 percent average increase in the tax that would otherwise be due from a newly constructed commercial project might significantly curtail new construction. "Old" commercial properties would, of course, enjoy a 36 percent average decline in property tax, but it is doubtful that the gratitude from this sector would go far toward placating irate homeowners or relieving those concerned with the possible decline in new commercial construction.

19. The mayor then might consider a compromise that affected all categories of taxable property "equally." One possibility would be to move halfway toward full value from present assessments and tax accordingly. Residential property currently relatively more underassessed (compared with the market value benchmark) would, of course, have to pay more than at present under this alternative too. But the average experience would be less of a jolt than in the various policies discussed in the several preceding paragraphs. The average property tax of residential properties would increase by 15 percent and "old" commercial properties would enjoy a 29 percent decline in property tax, while "new" commercial properties would find their property tax up by more than 50 percent. Homeowners would be less upset than under the other alternatives reviewed up to this point, but commercial developers could well find a 59 percent increase in taxes definitely discouraging.

20. Even more concern could be shown for the homeowner. Illustrative of these possibilities is a policy of adjusting residential properties in part to the new basis—the example we chose involved making half the adjustment called for—and making up the rest of the required tax revenue from the commercial sector. The average tax increase experienced by residential properties under this arrangement would be quite modest, about 10 percent. "Old" commercial properties would, nonetheless, enjoy a 32 percent cut in property tax payments, but "new" commercial properties would find their tax increased by an average of 95 percent. With this policy the mayor would be keeping the unhappiness of homeowners to a relatively modest level, but at the expense of severe discouragement to new commercial development.

21. Of course freezing the tax due from residences would be even more popular with homeowners. And it would also permit a slight fall in the tax on commercial properties (at the expense of "other" property) as compared with liabilities under current assessments. But within the commercial sector "new" properties would experience, on the average, more than a doubling of tax due, while "old" properties would find the property tax about 26 percent lighter.

22. All these policies reflect the conflicting pressures operating on the mayor in going from the current assessments to full-value assessment. That step would raise taxes on residences by more than a fifth and on "new" commercial properties by nearly 80 percent. Thus he would feel the wrath of voters (homeowners and renters) and face the prospect of a sharp curtailment of property development in the city. To the extent that he attempted to mollify the former he would accentuate the latter, and vice versa. Of course this is no new discovery. It is simply the specific property tax version of the iron law of politics. To the extent that the size of the pie is fixed you can only give more of it to A at the expense of less to B.

23. While these reflections are based primarily on the average results, they would be substantially modified if we were to take account of the diversity around the average. Some modest efforts in this connection are reported above; the results whet our appetites for more extensive work in this connection. Certainly that task is high on our list of further work to be done. Nonetheless, the inferences possible now without further extensive study suggest that taking account of the diversity of experience will illuminate still more difficult areas of trade-off. Thus in moving to full-value assessment we think it likely that a number of residential properties in Roxbury would enjoy a tax cut, since the divergence (in an upward direction) of their assessment from the residential average is greater than that sector's divergence (downward) from the average for all properties. But at the same time, political benefits from this prospect might be nullified by the large increase in tax liability on the homeowners in the other sections of the city.

What Can the Mayor Do?

While no elected official is likely voluntarily to undertake a tax policy irritating to sensitive sectors—the voting public (in their guise as homeowners and renters) and property developers—the mayor of Boston (and his counterparts in other cities and towns in the commonwealth) will not be able to avoid doing so, since the Massachusetts Supreme Judicial Court has mandated putting the property tax on a market value base.

In carrying out that mandate the mayor could avoid the large redistribution of tax liability, described earlier as likely, by finding more revenue. This can come from extending the property tax to real estate that the city does not now reach, or by getting more revenue from an additional tax not now levied by the city, or by stepped up grants-in-aid from the commonwealth or the federal government. With the additional revenues in prospect Boston could lower the effective rate of property tax on properties presently taxable and thus moderate the tax increases that most homeowners and others would otherwise experience on the adoption of market value assessment. For example, if \$55 million could be obtained from some other source and the property tax take were reduced by this amount, it would become an effective levy of 5.4 percent on market value, so that, generally, residential property, which is paying at just about that rate now, would find its property tax liability unchanged. And if even more were forthcoming, say \$75 million, then most residential properties would pay a lower property tax even under market value assessment.⁷ The \$55 to \$75 million required is between 20 and 25 percent of the present level of property tax collections. Where could such a sum come from? The answer obviously is a major study in itself. The several conjectures that make up the rest of this section are not the major contribution of our study. We bring them up here in the hope that they will induce others to join the discussion of alternatives or additional measures that might be employed. Our remarks are quite selective; the failure to cover a number of well-thought-out proposals already put forth should not be taken to imply criticism of them.

1. For a start, it is not unlikely that more could be wrung out of the property tax by identifying and placing on the rolls taxable property that is not now there and by getting new property on the rolls more rapidly. The Jacobs Company report (1971) pointed to a substantial shortfall between what the construction data suggested additions to the taxable rolls should be and what they in fact were. Whether this property is really "missing" or whether the explanation lies in a long lag in administration is not really important. Whether "found" or more speedily put on the rolls, some property not now taxed could be. Property tax revenues could be increased, or for an unchanged amount of property tax collections mill rates could be lowered. The amount of

7. Of course "old" commercial properties presently taxed would enjoy even more substantial declines than those suggested in our tables. But the envy that this would cause among owners of residential property is not likely to be as distressing politically as their anger in the face of full-value assessment with no cut in the mill rate.

Table 9.10. Volume of New Construction Compared with Annual Increase in Assessed Values, Boston, 1967 and 1968 (in millions of dollars)

	New construction reported by building department			Value increases reported by assessing department
	Total	Nontaxable	Net taxable	Total
1967	\$231	\$66	\$165	\$36
1968	211	32	179	22
Total	442	98	344	58

Source: Jacobs Company (1971, p. 83).

property involved here is not enough to solve the problem, but it might help substantially.

The report by the Jacobs Company provides the data found in table 9.10 that permit a comparison of new construction and increases in the valuation roll over several years.

While building department records indicated \$344 million of net taxable construction over the two years 1967 and 1968, taxable valuations rose by only \$58 million. Discrepancies of this magnitude are probably not due to a single factor. By way of explaining the shortfall we can suggest these possibilities: (1) assessed values are below market value; (2) some properties get "lost"; or (3) there is a lag in getting properties on to the tax rolls. To the extent that the two latter reasons explain the gap (the Jacobs report, 1971, page 84, implies they are important in this connection) then by improving the administration of the property tax Boston could raise the same amount of revenue it currently does with a lower mill rate.

This is only one instance of the rate reduction potential of administrative improvements in the property tax. For a careful documentation of the opportunities (or needs, if one prefers) in this connection, see the Jacobs report noted above.

In summary, then, one answer to the question "What can the mayor do?" is simply to improve property tax administration. This is something he should do in any case in order to make the most of the new property record system now in the process of installation, but it could be that a mandated shift to full-value assessment would sharpen the perception of the need and energize the will to undertake the task.

2. A tempting area to search for additions to the property tax base would appear to be property presently exempt from tax. In Boston the assessed value of tax-exempt property at \$1,725 million (in 1970) exceeds taxable property of \$1,617 million. Even more to the point, whereas taxable real property increased by \$280 million between 1960 and 1970, the value of tax-exempt property rose by \$850 million. If relative rates of

Table 9.11. Distribution of Exempt Property in Boston, 1969

Category	Percentage of total
United States of America	4.0%
Commonwealth of Massachusetts	42.3
City of Boston	33.3
Literary and scientific	6.1
Charitable and benevolent	3.9
Religious	2.7
Cemeteries	6.1
Other	1.4

Source: Jacobs Company (1971).

growth of this order of magnitude were to continue for the next decade, merely slowing down the additions to the tax-exempt sector by a more rigorous interpretation of the exemption privilege could add importantly to the tax base.

The present stock of tax-exempt real property, appears a tempting target, but the allure dissipates quickly when one examines its composition (see table 9.11). Boston is a capital city; consequently the vast mass of tax-exempt property, 80 percent, is owned by government. But this concentration, in fact, suggests an opportunity. While government property cannot now be taxed, the city could well seek payments from the commonwealth and the federal government in lieu of taxation. Mayor Kevin White has recently made a proposal in this connection to the effect that the commonwealth pay in lieu of property tax a sum equal to 20 percent of the property tax that would have been due if their properties had been subject to tax. If accepted this proposal alone would permit a 4-5 percent cut in the mill rate. A further cut of the same magnitude could be supported by getting half the nongovernment properties presently exempt from tax on the tax rolls.⁸ This is probably unlikely to be accomplished, but, needless to say, the mayor should push as hard as he can in this area. Also, of course, he need not remain content with in-lieu payments equal to one-fifth of the tax that might have been due, but could press for a higher percentage.

Given his present fiscal powers these two attempts—improving property tax administration and curbing and reversing tax exemption and obtaining in-lieu payments with respect to it—exhaust the opportunities available to the mayor of Boston, who basically is limited to the real

8. New York City has recently successfully added to the tax rolls the property of bar associations and scientific organizations as a result of legislative and judicial decisions. See *Association of the Bar of the City of New York v. Lewisohn*, 34 N.Y.2d 143 (1974).

property tax in his search for revenue. Of course the mayor can also levy charges and fees, and undoubtedly there is some revenue potential in this source, but as a quick judgment (and necessarily, therefore, provisional) there does not seem to be enough new revenue here to offset substantially the need for property tax revenue. Moreover, the mayor would be well advised to pay appropriate attention to allocation effects, as well as maximum revenue, in designing the structure of fees and charges.

3. Right now the mayor would probably like the power to tap a new major revenue source. Were he required to tax property at full market value, he would feel the need more intensely. Were he able to add some points to the sales tax for city use or to institute a city income or payroll tax, the city could raise enough to support a sizable cut in the property tax rate. So another course of action for the mayor is to seek the power to levy one or several new major taxes.

Of course to relieve the rate of property tax it is not necessary that the city do the job. It could be effectuated (and, perhaps in a superior fashion) by actions at the state level. Increased state income and sales tax revenues could be used by the state to finance or assume the operation of selected municipal programs such as mass transportation, parks, refuse disposal, courts, and libraries or to finance all or part of the cost of state-mandated property tax exemptions based on personal characteristics (age, widow, veteran) of the owner-occupant. A particularly promising approach, we think, is embodied in the Master Tax Plan Commission proposal which would, in essence, (1) abate the effective rate of property tax for local governments in the commonwealth by converting the tax substantially to an almost uniform, statewide levy for local governments' use; (2) keep the property tax to a specified (and lower than at present) fraction of total commonwealth and local revenues; and (3) have the state increase sales and income taxes to raise the additional funds needed by local government. The mayor of Boston could only applaud any recasting of revenue structure to give the state and the broad revenue raisers it has exclusive use of—income and sales taxes—a greater role and the property tax a lesser one, provided Boston received its proper share of the revenues so raised.⁹ One more thing the mayor can do, then, is to support and encourage greater use of the income tax (and possibly the sales tax as well) and a smaller role for the property tax. Given the present distribution of fiscal powers between the

9. Changes of the sort envisioned by the Master Tax Plan Commission carry with them a complete overhaul of the formulas and arrangements for state aid to local government. Moreover, the *Sudbury* decision may well precipitate state legislative action on state aid distribution. It may therefore be only of temporary importance to note that full valuation under current state aid arrangements may be costly to Boston.

commonwealth and its cities and towns, this means exhorting and encouraging the commonwealth to undertake the initiative and responsibility. A strong effort to get the Master Tax Plan Commission to issue its final report would be an important first step.

4. Another interesting proposal is the subject of a recent report by the Boston Urban Observatory (1973). In this study a case is made for state assumption of responsibility for a range of municipal services including public transit and safety, solid waste and sewage, health and hospitals, regional parks and recreation, and some others. The tax saving involved for Boston would, it is estimated, "be equivalent to about 26 percent of the 1973 property tax levy."

In brief summary, it appears that there are real possibilities of raising additional revenues from other sources and/or shifting the fiscal responsibility for some expenditures currently financed by Boston to permit a shift to full-value property taxation without unduly increasing the taxes due from the "average" homeowner.¹⁰ But the mayor of Boston cannot pull the necessary levers on his own. Cooperation and involvement at the state level will be required.

5. Finally, more for serious consideration than immediate implementation, we suggest the possibility of a levy, separate and distinct from the property tax, on land value per se. It would be applicable to all properties, including, therefore, those exempt from the property tax. The levy on land value could be considered a charge to be paid by all properties in the city because they all make some demand on city facilities and require city services. Structured as a charge, it should, in principle, be applicable also to real estate exempt from the property tax. To view such a charge as a modest rental fee for occupying space at the Hub of the World might be one of the more appealing ways of presenting the idea.

With land estimated at one-fourth to one-third of the total value of property, and with the value of tax-exempt property at least as great as taxable property, the land value charge at a rate equivalent to 1 percent would raise on the order of \$24-32 million and might have a healthy impact on the allocation of land uses. (If the levy were limited to taxable property, revenue would be between \$12 and \$16 million.) Either sum could replace an equivalent amount of property tax, lowering the latter's effective rate and moderating the impact of full-value assessment. Moreover, it is likely that the land value charge would further work to moderate the strength of the redistributions to be expected from full-value assessment, because it would fall differently from the property tax.

10. Attendant upon the new assessment, however, residential properties now grossly relatively under-assessed or over-assessed would have major changes in their tax bill.

Presently in Boston for each property separate assessments are made for the land and improvement components. While no pretense is made at accuracy for each component (the primary interest attaching to the accuracy of the assessment of the property per se, that is, the land plus improvements), the ratio of land to total value is different enough among different categories of property is probably truly different. The ratio appears to differ significantly for "old" and "new" commercial properties. From the sample of commercial properties we used in estimating assessment-sales ratios, we separated "old" (181 properties) and "new" (35 properties) and calculated the ratio of land to total property value. For "old" it came to 0.4, while for "new" it was 0.2. (Too much weight should not be given to these two numbers, however. We were unable to obtain sufficient information to be confident about the magnitude of the difference.) These results generally conform to what might be expected since "old" properties built in periods of lower land prices would be less intensively developed than "new" properties. Thus the land value charge at the same rate (percentage) for all properties would bear more heavily on "old" than on "new" commercial properties, which would have an impact that would tend to soften somewhat the tax blow on "new" commercial properties to be expected from assessment at 100 percent of market value and also to tone down the tax decrease that "old" commercial properties would experience.

APPENDIX A: Methods Used in Deriving Estimates of Market Value and Assessed Value for Taxable Real Property, as of 1972, in Boston

In this appendix we will summarize briefly the methods by which we estimated market and assessed value by class of taxable property. And we will also compare our estimates with those of other studies. A detailed description of the procedures employed can be found in Holland and Oldman (1974, section 3).

First, in table 9.12 we will take up the estimates of market value for most categories of taxable commercial real property, for which a common methodology was used. Then we will briefly explain the remainder of the market value estimates. Finally, we will indicate in table 9.13 assessment-sales ratios which, together with the estimated market values, furnished the estimates of assessed value.

Since 1960, we take it, most of the commercial real property built in the city of Boston has been covered by agreements between the developers and the city which set the property tax liability at a specified fraction of gross income from the property, with the result that assessed values and effective rates of tax run lower than those that apply to commercial

Table 9.12. Estimation of Market Value of Various Categories of Commercial Real Property, Boston, 1972

Category of property (1)	Estimated physical amount (millions of square feet) (2)	Estimated replacement cost per square foot (3)	Land as percentage of total value (4)	Estimated land value per square foot ^a (5)	Depreciation factor (6)	Estimated improvement value per square foot ^b (7)	Total value per square foot ^c (8)	Total market value in category ^d (millions of dollars) (9)
Office								
New	6.7	\$ 43.18	25%	\$ 14.39	4.2%	\$ 41.37	\$ 55.76	\$374
Old								
Class B	5.3	24.54	25	7.88	25.9	18.41	26.29	139
Class C	11.9	18.02	25	6.00	25.0	13.52	19.52	232
Total	23.9							745
Retailing								
New	3.7	34.56	27	12.78	4.2	33.11	45.89	170
Old	18.3	16.43	25	6.08	25.0	12.32	18.40	337
Total	22.0							507
Hotels								
New ^e	1,563 ^f	30,000 ^g	25	7,500 ^h	4.2	21,555 ⁱ	29,055 ^j	45
Old ^k	4,643		25		25.0		13,011	60
Total	6,206							105
Manufacturing								
New	1.0	25.16	20	6.04	6.8	22.52	28.56	29
Old	29.0	11.34	20	2.84	25.0	8.51	11.35	329
Total	30.0							358
Warehousing								
New	2.0	17.04	25	5.63	5.5	16.10	21.73	43
Old	10.0	9.43	25	3.14	25.0	7.07	10.21	102
Total	12.0							145

^a Column 5 = [column 3 ÷ (100.0 — column 4)] — column 3.^b Column 7 = column 3 × (100.0 — column 6).^c Column 8 = column 5 + column 7.^d Column 9 = column 2 + column 8.^e Since in our hotel estimates column 2's costs include land, the estimation of market values is different for this category than for the others in the table.^f Number of rooms.^g Per room.

properties of earlier vintage. Therefore, we developed separate estimates for these two categories of taxable commercial real property. In what follows, properties constructed before 1960 will be referred to as "old," while those built from 1960 on will be designated as "new."

While market values were developed separately for "old" and "new" commercial property, similar methods were employed in making the estimates. Market value is derived as the product of a physical amount of property¹¹ and the per unit cost (construction and land) of reproducing the property.¹²

By way of summary, then, our basic assumptions in deriving market values of most classes of taxable commercial real property were that the current value of that property is equal to the sum of the construction costs of replacing the structure (depreciated back to the time of construction, on the average)¹³ and the value of the land on which the structure stands.

Table 9.12 summarizes the estimates for most categories of commercial property.

Property Categories Not Explained in Table 9.12

Commercial Personal Services Not Included in Office Space (SNIOS)

For one major category of commercial property there is not sufficient information for estimating market values in the manner just described. This category is made up of a vast variety of personal services, including laundries, barber shops, beauty parlors, repairs of all kinds, auto and equipment rentals, motion pictures, amusements and recreation, edu-

11. Square feet for all categories but hotels, for which the physical unit was number of rooms.

12. For estimates of the physical amount of property by category (office, retail, hotels, manufacturing, and warehousing) we are indebted to the Boston Redevelopment Authority (BRA) and wish to thank Alex Ganz and Susan Houston particularly. Replacement costs (exclusive of land) for the most part came from the *Stevens Valuation Quarterly*. Land costs (values) were estimated on the basis of typical ratios of land to other costs suggested by Theodore R. Smith of the Harvard Law School International Tax Program. Smith has cautioned that these ratios are approximations subject to wide margins of error. We thank him for his help and absolve him from blame in our specific use of the information he provided.

13. The cost approach to valuation is well recognized in this state and elsewhere, especially with respect to properties which are not obsolete in use or are relatively new. See, for example, Commonwealth of Massachusetts, Department of Corporations and Taxation (1973); Bonbright (1937, chap. 8, pp. 144-45); *Seagram v. Tax Com'n*, 18 App. Div. 2d 109, 238 N.Y.S. 2d 228 (1963), affirmed 14 N.Y. 2d 314, 251 N.Y.S. 2d 460, 200 N.E. 2d 447; and *Matter of 860 Fifth Ave. Corp. v. Tax Com'n*, 8 N.Y. 2d 29, 32, 167 N.E. 2d 44S, 456 (1960).

cation, museums, and so on. To arrive at a figure for the market value of commercial property in this category, we utilized payroll data relying on the assumption that in the main the ratio of payrolls to market value of premises is substantially similar across industries, so that this sector's share of payrolls in Boston would be a reasonable proxy for its share of commercial property.

Utilities and Transportation

Utilities (electricity, gas, and telephone) hold extensive amounts of property in Boston, but very little of it shows up in the tax rolls in a way that is germane to our study. Most of what utilities own is, apparently, classified as personal property, while two very important transportation facilities are not on the taxable rolls, one being owned by the Boston Redevelopment Authority and the other by the Massachusetts Bay Transit Authority.

Thus, the five utility companies—American Telephone and Telegraph, New England Telephone, Western Union, Boston Edison, and Boston Gas—were assessed on the taxable rolls in 1972 for \$7.1 million of real property (this is the figure relevant for our study) and \$154 million of personal property. With respect to transportation, the Greyhound Terminal was assessed at \$1 million, Trailways Terminal at \$175 thousand, North Station (difficult to identify in the records) at something like this or less, while South Station, owned by the BRA, and Back Bay Station, owned by the MBTA, were, of course, exempt from the property tax.

With identified taxable utility real property assessed at around \$7 million and taxable transportation real property assessments on the order of \$1.5 million, a total of \$10 million for this category seemed reasonable. On the assumption that these properties are assessed by the state at 100 percent of market value, we estimated both the assessed value and market value of taxable properties in this category as \$10 million. In the tabulations, we put all of this category of real property under "old."

Residential

An estimate by the Boston Redevelopment Authority (BRA) which appeared in a memorandum of April 30, 1973, explains its derivation of the value of all residential property as follows:

The total residential figure was developed primarily from a BRA report entitled "The Housing Stock of the City of Boston by Neighborhood." This source, based on 1970 census material, presented the aggregate 1970 market value of all housing for each neighborhood in Boston. Briefly, the market value figures were, for single-family housing, based on capitalization of rents. Capitalization rates were

developed for each neighborhood on the basis of information on vacancies, trends of residential sales prices, and family income. To update the 1970 values to 1972, price indices were used. These indices were developed for the same neighborhoods as were presented in "The Housing Stock" and reflected the change in sales prices for all residential property that had been sold at least twice. These indices were applied to each of the neighborhood market value figures for 1970, and, with some modifications for actual changes in the housing stock, the resulting 1972 values were summed to the total figure of \$2.602 billion.

But this figure, based on approximately 232,000 dwelling units, includes all taxable and tax exempt residential properties. Taxable properties alone number about 214,000.

Adjusting simply on the proportion of the number of exempt residential units to the total number of dwelling units (that is, taking

$\frac{214,000}{232,000}$ of the total value of \$2.6 billion) would be inappropriate, since

tax-exempt housing (primarily public housing) generally has a lower average value than taxable housing. From a study on subsidized housing by the Boston Urban Observatory (1972) an estimate of \$21,000 per subsidized dwelling unit ("new" construction) was obtained, and Mark Gilman and Robert Earsy of the BRA estimated an order of magnitude cost of \$30,000 per dwelling unit for "new" private construction. Assuming these two figures to indicate the *relative* values of exempt and taxable dwelling units, respectively, we lowered \$2.6 billion by (1—

$\frac{214,000}{232,000} \times \frac{\$21}{\$30}$) to get \$2,456 million as our estimate of the market value

of taxable residential property.¹⁴

Other

This category is derived by working backwards from the assessed value estimates of table 9.13 and an ASR of .23—the same as that reported in U.S. Bureau of the Census (1973, p. 127) for vacant platted land, since vacant lots represented virtually the whole of locally assessed taxable real property not accounted for by commercial and residential in 1966, the most recent year for which such estimates are available.

Specifically, in Boston in 1966 residential and commercial and industrial (which combined category we have been referring to as commercial) made up 96.6 percent of the total; vacant lots accounted for 3.1 percent;

14. The data on number of housing units used in this estimate are available due to the generosity of Susan Houston of the BRA.

and what the Census of Governments designated as "other and unallocable" represented 0.3 percent. Our "other," amounting to 3.4 percent, is the sum of these two latter categories (for the data see U.S. Bureau of the Census, 1968, p. 132). Having estimated the assessed values for commercial and residential as described in the notes for table 9.13, we were able to derive a figure for "other" on the assumption that

Table 9.13. Derivation of Current Assessed Value of Real Property from Estimated Market Value, Boston, 1972

Property category	Estimated market value (millions of dollars)	Assessment- sales ratio	Estimated assessed value (millions of dollars)
<i>Commercial</i>			
Office			
New	\$ 374	.18	\$ 67
Old	371	.52	193
Total	745		260
Retail			
New	170	.18	31
Old	337	.52	175
Total	507		206
Hotel			
New	45	.18	8
Old	60	.52	31
Total	105		39
Manufacturing			
New	29	.32	9
Old	329	.52	171
Total	358		180
Warehousing			
New	43	.14	6
Old	102	.52	53
Total	145		59
Personal services (SNIOS)			
New	35	.18	6
Old	70	.52	36
Total	105		42
Utilities and transportation (tabulated with old)	10	1.00	10
<i>All commercial</i>			
New	696		127
Old	1,279		669
Total	1,975		796
<i>Residential</i>	2,456	.27	663
<i>Other</i>	222	.23	51
<i>All taxable property</i>	4,653		1,510

this category represented the same percentage of total assessed value in Boston in 1972 as it did in 1966.

Then, as explained above, we estimated the market value of other property on the assumption that the assessed value was 23 percent of market value, ending up with \$222 million.

Assessed Values

Introduction

From the market values whose derivation has been explained above, we obtained estimates of assessed value for each category of taxable real property by application of assessment-sales ratios, that is, ratios assembled from the data of real property sales whose numerator is the assessed value of the property sold and whose denominator is the selling price. In table 9.13, we list the assessment-sales ratios used for each category of property, and in the discussion that follows the table we explain very succinctly the source of each.

Derivation of Assessment-Sales Ratio for "Old" Commercial Properties

For "old" commercial properties we developed an assessment-sales ratio based on sales of commercial properties in 1972. For this purpose commercial was taken to mean all taxable real properties other than residences.

The sample used in deriving the ratio was drawn from a data base consisting of all reported sales of commercial properties in 1972. From the 240 seemingly separate transactions that made up the basic data, 51 were excluded as invalid or inappropriate. The final sample, therefore, contained 189 sales.

"New" Commercial Properties

To obtain the equivalent of ASRs for "new" commercial properties, we calculated weighted averages of the ratios of assessed value to development costs for particular properties in each of four categories. For fifteen commercial office space buildings the ratio (weighted by development cost which was assumed equal to market value) was .18, in our sample of thirteen retail properties it was .18, a sample of six manufacturing properties had a ratio of .32, while for nine warehousing facilities it was .14. For "new" hotels we made no survey but used the .18 for an ASR, since this appeared to be the typical value for "new" commercial properties. And we did the same for SNIOS.

The ASR of 1.00 for utilities and transportation, as has been explained above, reflects our understanding that the state values such

properties at 100 percent of market. In any event the value of taxable property in this category is very small, so an error in the ASR is inconsequential.

"Old" and "New" Residential Property

The ASR of .27 for all residential property—"old" and "new"—is the figure given for all residential (nonfarm) property for Boston in U.S. Bureau of the Census (1973, p. 127).

Other Property

As noted earlier the ASR of .23 is that reported for vacant platted land (the predominant component of "other") in U.S. Bureau of the Census (1973, p. 127).

Evaluating Our Estimates

We noted above that while at every juncture we chose those assumptions and data that seemed most "appropriate," the wide variety of plausible alternatives not chosen suggests that our estimates cannot be validated on a priori grounds, but, like the pudding of the proverb, can only be evaluated in the eating.

Therefore it is quite comforting to find that the assessed value estimates conform very closely to two control totals:

1. The Boston Assessors Office tabulation of taxable assessed value in 1972 was \$1,532 million. Our estimate of taxable assessed value, independently derived from our market value estimates, is \$1,510 million, which differs from the tabulated total by less than 2 percent.

2. For 1966 (the most recent year for which such a breakdown was available), the *Census of Governments, 1967* puts commercial property at 55.4 percent of total assessed value of taxable real property, residential at 41.1 percent, and other property at 3.4 percent. Our estimates for 1972 for these three classifications are 52.7, 43.9, and 3.4 percent, respectively. The similarity in the proportion accounted for by other property in the two totals simply reflects our methodology. But the close correspondence for the other two categories suggests to us that some measure of confidence can be placed in our estimate of market values and the assessed values derived from them.

Of course, the results just reported could be consistent with major errors in the specific categories making up the commercial total or in the division between "old" and "new." This suggests that we can place more

confidence in the broad redistribution of property tax liability between commercial and residential that is indicated by our estimates than we can in the redistributions within the commercial total. But, after all, it is the former redistribution, not the latter, that is our prime concern. The judgment that the direction of the redistributions we have identified and their general orders of magnitude are rather "robust" results is reinforced by a comparison of our estimates of market value with those made by others.

We have found two other sets of estimates of the assessed value and the market value of taxable property in Boston as of substantially the same date as ours. As we have already explained, while it is our judgment that our estimates are the "best" we could make, they are far from definitive. Therefore it is useful to compare them with the other available estimates to judge how our results would be modified were we to use these other sources as the basis for estimating the tax redistribution among classes of property.

The other two studies (see footnote 3) and ours all employ somewhat different classifications of taxable property; comparability among them is possible only on the broadest bases. Specifically we compare the tax burden redistribution with respect to just two broad sectors: between residential property and "all others" (which makes up the rest of taxable property).

One of the studies, hereinafter designated "Bureau," was the annual equalization study undertaken by the Bureau of Land Assessing of the Department of Corporations and Taxation of the Commonwealth of Massachusetts, and consists of estimates of assessed value and market value as of the end of 1973. (We are indebted to William C. Wheaton for bringing this source to our attention.) The study groups taxable property in four classes: residential, industrial, commercial, and personal. We excluded personal property from our study and subtracted it from the bureau's totals in the comparisons we will make. In deriving the entries of table 9.14, their commercial and industrial were summed to get "all other," which with residential adds up to a total taxable property figure comparable with our aggregate.

The other independent source, hereinafter designated "Equalization," as yet unpublished, is the 1974 equalization study of the Department of Corporations and Taxation of the Commonwealth of Massachusetts. Again as of the end of 1973, assessed values and market values are estimated for commercial, industrial, land, and residential properties. For comparison we lumped the first three under the category of "all other."

Finally, our own estimates (Holland and Oldman, 1974) are arrayed

Table 9.14. Comparison of Three Estimates of Assessed and Market Value of Taxable Property in Boston and Tax Burden Redistributions^a

Source	Assessed value (millions of dollars)	Market value (millions of dollars)	Residential				All other			
			Proportion of total		Percentage of total tax redistri- buted	Relative change in tax	Proportion of total		Percentage of total tax redistri- buted	Relative change in tax
			Current assessed value	Market value			Current assessed value	Market value		
"Bureau"	\$1,529	\$4,353	.5186	.6552	+ 13.66	+ 26%	.4814	.3448	-13.66	-28%
"Equaliza- tion"	1,535	4,880	.3211	.4207	+ 9.96	+ 31	.6789	.5793	- 9.96	-15
Holland and Oldman (1974)	1,510	4,653	.4391	.5278	+ 8.87	+ 20	.5609	.4722	- 8.87	-16

^aSee text for sources and explanations of method.

into a comparable classification, by summing up "new" commercial, "old" commercial, and "other" to obtain an "all other" category which together with residential accounts for aggregate taxable property as of the end of 1972.

For purposes of table 9.14 tax burden change is calculated by the "initial impact" method.¹⁵

Turning to that table we note that the three estimates show remarkable agreement with respect to the aggregates. This is not as noteworthy for assessed value as for market value, since two of the three sources had available to them a *tabulated* breakdown of assessed value among categories of property.¹⁶ But the close correspondence of the three estimates of market value is truly surprising.

Other things equal, the similarity among these three independent estimates would be encouraging. But other things are not equal. The sharp disparity in the proportions that residential and all other property constitute of total current assessed value and total market value in the three studies removes much of the encouragement. It is clear there is a great variation in the estimates of the components of the total, most likely due to differences in the basis of classifying larger residential properties which at least one of the other sources probably tabulates under commercial.

There is no way to determine which estimate is most correct.

We have Pygmalion's preference for our own creation, but have no strong basis other than parental pride to credit it above the others. There is a lesson, however, in table 9.14. Our method provides both the smallest amount of tax redistribution (see the percentage total tax redistributed figures) and the smallest relative change in taxes. We may conclude, therefore, that to the extent that either of the others or both are truly more correct than Holland and Oldman (1974), we have understated the amount of tax burden redistribution to be expected from 100 percent of market value assessment and the relative change in sector tax burdens caused thereby. And therefore we have understated the change in value of properties caused by the redistribution of tax liabilities among classes of property.

15. Specifically, to allocate the property tax burden on the basis of current assessed values, we use pro rata shares of the assessed value total; to allocate it on the basis of market values, we use each class's proportion of the total market value. The relative (percentage) tax change is the ratio of the difference between the shares on these respective bases and the share that the classification currently bears.

16. We remind the reader that Holland and Oldman (1974) did not. We, in effect, estimated assessed value from market value.

Table 9.15. Explanation of the Derivation of "Initial Impact" Tax Change Estimate, Boston, 1972 (dollar amounts in millions)

Property category	Assessed value (1)	Proportion of assessed value (2)	Current property tax (3)	Current market value (4)	Proportion of current market value (5)	Property tax based on market value (6)	Effective rate of property tax on current market value (8)	Change in property tax (8)	Percentage change in property tax (9)	Effective rate of tax "initial impact" (10)
"New" commercial	\$ 127	.0841	\$ 25.77	\$ 696	.1496	\$ 45.84	3.7%	+\$20.07	+ 78%	6.6%
"Old" commercial	669	.4430	135.74	1,279	.2749	84.23	10.6	— 51.51	—38	6.6
All commercial	796	.5271	161.51	1,975	.4245	130.07	8.2	— 31.44	—19	6.6
Residential	663	.4391	134.54	2,456	.5278	161.72	5.5	+ 27.18	+20	6.6
Other	51	.0338	10.36	222	.0477	14.61	4.7	+ 4.25	+41	6.6
Total	1,510	1.0000	306.40	4,653	1.0000	306.40	6.6	—	—	6.6

In short, as compared with our study the other available estimates suggest larger property tax liability redistributions than ours, relatively heavier changes in tax burdens by class of taxable property, and more pronounced changes in property values.

APPENDIX B: Explanation of Methods of Estimating Property Tax and Property Value Changes

In this appendix we will explain the methods of estimating tax and value changes that were used in our study.

"Initial Impact" and "First Iteration"

A straightforward way to estimate property tax redistributions to be expected from full value assessment is to (1) allocate a given amount of property tax among specified categories of assessed value on the basis of their proportionate share of total assessed value; (2) do the same on the basis of market value proportions; and (3) take the difference between the two tax liabilities in each category of property to be the tax change to be expected from a shift to market value on the basis of assessment for property tax purposes. Tax changes estimated this way, we call "initial impact" estimates. The magnitudes associated with their derivation appear in table 9.15.

By way of specific example, "old" commercial property had an assessed value of \$669,000,000 (column 1), which came to .4430 of total assessed value of taxable property (column 2). Currently (as of 1972), then, this category is subject to .4430 of total property tax collections or \$135,740,000 (column 3). But "old" commercial property, relatively over-assessed, constitutes a lower fraction of market value, .2749 (column 5). Applying this proportion to the total tax of \$306,400,000 indicates the tax due from "old" commercial property on a market value basis would be \$84,230,000 (column 6). Thus, under full value assessment the property tax on "old" commercial property would decline by \$51,510,000 (column 8) or by 38 percent (column 9). Finally, a summary measure, with reference to market value, the current property tax on "old" commercial property is at an effective rate of 10.6 percent (column 7). Under 100 percent of market assessment, this category, and all others, would be subject to an effective rate of 6.6 percent.

This simple arithmetic exercise is one way of estimating the distributive impact of full-value assessment. While we call it the "initial impact" method, in fact redistributions as severe as this might not occur even initially. In any event the "initial impact" magnitudes would be

Table 9.16. Explanation of the Derivation of "First Iteration" Value Change Estimate, Boston, 1972 (dollar amounts in millions)

Property category	Change in value due to change in tax ^a (1)	"First iteration" market value ^a (2)	Change in value due to change in property tax ^b (3)	"First iteration" market value ^b (4)
"New" commercial	-\$134	\$ 562	-\$201	\$ 495
"Old" commercial	+ 343	1,622	+ 515	1,794
All commercial	+ 209	2,184	+ 314	2,289
Residential	- 181	2,275	- 272	2,184
Other	- 28	194	- 43	179
Total	—	4,653	—	4,653

^a Assumes capitalization rate of 15 percent.

^b Assumes capitalization rate of 10 percent.

quite ephemeral. We use this measure because of its simplicity and directness, and because this is the measure that has been most commonly employed in discussions of property tax redistribution.

The "initial impact" method might also be justified by the argument that with shift to a new basis for tax purposes, assessors, facing the possibility that their valuations will be challenged and, perhaps, brought to litigation, will base their assessments on the evidence a court would accept, that is, what the property could sell for in the market at the time of valuation. This is not a very supportive argument for anything more than a very brief life, if any, for the "initial impact" estimates.

For as soon as a new distribution of a given total tax liability is struck, every property can be expected to have a new market value that reflects the change in its tax. In the aggregate the market value of property in Boston will remain the same (since the total tax levied on it would not change), but all properties whose taxes are now higher will fall in value, while those enjoying lower tax liabilities will be worth more than before. So a second set of market values would be established by going to full-value assessment, aggregate tax collections remaining unchanged. But this set of market values, too, will prove evanescent, as a new distribution of tax liabilities based on them will, once again, induce a change in the underlying structure of values, and so on.

Specifically, were "old" commercial property to enjoy a tax decrease of \$51,510,000 it would become more valuable than at present. Assuming first that current market values do not reflect expectations of a shift to full value for tax purposes in any way and second that the capitalization rate for real estate in Boston is 15 percent, "old" commercial property would be worth \$343,000,000 more (column 1 of table 9.16). This is the change in value as estimated by the "first iteration" method which is the logical counterpart of the "initial impact" tax change. In our judgment a rate of 15 percent is appropriate for capitalizing properties in Boston, but we have also provided in table 9.16 estimates based on a 10 percent rate (columns 3 and 4).

But the "first iteration," too, may, in fact, never occur; and if it did, it could have a very limited time span of relevance. For, if the value of "old" commercial properties increases by \$343,000,000, they would be subject to higher property tax payments, which, in turn, would cause a change in value, and so on. Even within their rigid framework, then, the "initial impact" and "first iteration" estimates are not likely to be relevant for more than a brief period, and if investors expect the shift to full-value assessment to take place, these values will never transpire. Thus the "initial impact" and "first iteration" estimates are more appropriately considered the upper bound on a range of possible values.

The Iterative Process

We have been sketching out a process of tax change leading to a value change that could be spun out interminably, since there would be an infinite number of changes in market value determined by the process. This is not a realistic description of how the market would operate, but it is useful to analyze the process, since our "steady state" estimates are equivalent to the limiting values of the iterative process.

Our understanding of this process and the analysis that follows draws very heavily on the work of Dickstein (1974). Following Dickstein, we define V_i as the value of property at time i , T_i as the tax on property at time i , C as the capitalization rate, and E as the effective rate of tax on market value.

Start the process of tax change, value change, tax change, etc., after the first set of new tax liabilities which determine the tax change, ΔT_1 , under full value assessment have been determined. Then for any given property or class of property, Dickstein derives the following:

$$\begin{aligned}
 (1) \quad & \Delta V_1 = \Delta T_1 / C; \\
 (2) \quad & \Delta T_2 = \Delta V_1 \cdot E, \quad \text{and} \quad \Delta T_2 = \Delta T_1 (E/C); \\
 (3) \quad & \Delta V_2 = \Delta T_2 / C, \quad \text{and} \quad \Delta V_2 = \Delta T_2 / C; \\
 & \quad \quad = \Delta V_1 \cdot E / C \quad \quad \quad = \Delta T_1 (E/C^2) \\
 (4) \quad & \Delta T_3 = \Delta V_2 \cdot E, \quad \text{and} \quad \Delta T_3 = \Delta V_2 \cdot E; \\
 & \quad \quad = \Delta V_1 \cdot E^2 / C \quad \quad \quad = \Delta T_1 (E^2/C^2) \\
 (5) \quad & \Delta V_3 = \Delta T_3 / C, \quad \text{and} \quad \Delta V_3 = \Delta T_3 / C; \\
 & \quad \quad = \Delta V_1 \cdot E^2 / C^2 \quad \quad \quad = \Delta T_1 (E^2/C^3).
 \end{aligned}$$

Or, in the general case,

$$\begin{aligned}
 (6) \quad & \Delta V_n = \Delta V_1 \cdot E^{n-1} / C^{n-1}, \text{ and} \\
 (7) \quad & \Delta T_n = \Delta T_1 (E^{n-1} / C^{n-1}).
 \end{aligned}$$

If $E > C$, then the changes in tax and value get larger with successive iterations in the process since the value of $(E/C)^{n-1}$ increases with n . If $E = C$, the value of $(E/C)^{n-1}$ is constant. The process would not converge. The same tax and value changes would occur period after period. If $E < C$, $(E/C)^{n-1}$ approaches zero as n gets larger, hence the tax and property value change would be smaller with successive periods. The process tends to converge toward a limiting value. This limiting value is the same as our "steady state" estimates to which we now turn.

Table 9.17. Explanation of the Derivation of "Steady State" Estimates of Tax and Property Value Changes, Boston, 1972 (15% capitalization rate) (dollar amounts in million)

Property category	Current market value (V_0)	Capitalization rate (r)	Capitalization rate times current market value (rV_0)	Current property tax (T_0)	Estimated revenues gross of tax (R)	New property tax rate (t_1)	Capitalization rate plus new property tax rate ($r + t_1$)	"Steady state" market value (V_1)	Change in market value (ΔV)	Percentage change in market value	"Steady state" property tax (T_1)	Change in property tax (ΔT)	Percentage change in tax
"New commercial	\$ 696	.15	\$104.40	\$ 25.77	\$ 130.17	.06585	.21585	\$ 603	-\$ 93	-13%	\$ 39.70	+13.93	+54
"Old commercial	1,279	.15	191.85	135.74	327.59	.06585	.21585	1,518	+ 239	+19	99.96	-35.78	-26
All commercial	1,975	.15	296.25	161.51	457.76	.06585	.21585	2,121	+ 146	+ 7	139.67	-21.85	-14
Residential	2,456	.15	368.40	134.54	502.94	.06585	.21585	2,330	- 126	- 5	153.43	+18.89	+14
Other	222	.15	33.30	10.36	43.66	.06585	.21585	202	- 20	- 9	13.30	+ 2.94	+28
Total	4,653	.15	697.95	306.40	1,004.36	.06585	.21585	4,653	-	-	306.40	-	-

"Steady State"

Were assessors and investors to expect a shift to full valuation for tax purposes, and act with perfect knowledge, values would be set which short-circuited the "iterative" process, and which, in principle, reached the limiting value at once. Our judgment is that the "steady state" is the more realistic of the two sets of estimates and the values toward which value and tax adjustments would tend. The "steady state" estimates of tax and value changes are always smaller than the "initial impact" and "first iteration." Thus the "steady state" is a lower bound on our "predictions" and the "initial impact" and "first iteration" an upper bound. Our judgment is that tax and value changes toward the "steady state" end are more likely to eventuate.

If a property yields a return of R , net of all costs but property tax, T_o , the present value of the returns to the owner of the property, V_o , is $R - T_o$ discounted at the rate appropriate for investments of that class, r .

$$V_o = \frac{R - T_o}{r}, \quad \text{and} \quad rV_o + T_o = R.$$

R is derived in table 9.17.

To illustrate with the data for "old" commercial property: $V_o = \$1,279,000,000$; $T_o = \$135,740,000$; and $r = .15$. Therefore

$$\begin{aligned} R &= rV_o + T_o, \\ &= .15(\$1,279,000,000) + \$135,740,000, \\ &= \$191,850,000 + \$135,740,000, \\ &= \$327,590,000. \end{aligned}$$

Having R , we can estimate what the market value would be *given the tax rate* that would apply under full-value assessments by noting that the new market value, V_1 , would equal the return gross of tax capitalized by the sum of the capitalization rate and the effective rate of property tax, t_1 . The latter, of course, under full-value assessments would be the same for all properties.

$$V_1 = \frac{R - t_1 V_1}{r}, \quad rV_1 + t_1 V_1 = R, \quad \text{and} \quad V_1 = \frac{R}{r + t_1}.$$

Under a full-value assessment scheme t_1 is the same for all properties. Specifically, in our study t_1 is .06585 (that is, 6.585 percent) the rate which if applied to all taxable property would yield the sum actually raised by property tax in Boston in 1972: \$306,400,000.

Table 9.18. Explanation of the Derivation of "Steady State" Estimates of Tax and Property Value Changes, Boston, 1972 (10% capitalization rate) (dollar amounts in millions)

Property category	Capitalization rate (r)	Capitalization rate times current market value (rV_0)	Estimated gross of tax (R)	Capitalization rate plus new property tax rate ($r + t_1$)	"Steady state" market value (V_1)	Change in market value (ΔV)	Percentage change in market value	"Steady state" property tax (T_1)	Change in property tax (ΔT)	Percentage change in tax
"New" commercial	.10	\$ 69.60	\$ 95.37	.16585	\$ 575	-\$121	-17%	\$ 37.86	+\$12.09	+47
"Old" commercial	.10	127.90	263.64	.16585	1,590	+ 311	+24	104.70	- 31.40	-23
All commercial	.10	197.50	359.01	.16585	2,165	+ 190	+10	142.56	- 18.95	-12
Residential	.10	245.60	380.14	.16585	2,292	- 164	- 7	150.93	+ 16.39	+12
Other	.10	22.20	32.56	.16585	196	- 26	-12	12.91	+ 2.55	+25
Total	.10	465.30	771.70	.16585	4,653	-	-	306.40	-	-

Once again using the data for "old" commercial property to illustrate:

$$\begin{aligned}
 R &= \$327,590,000, \\
 r &= .15, \\
 t_1 &= .06585, \\
 V_1 &= \frac{R}{r + t_1}, \\
 &= \frac{\$327,590,000}{.15000 + .06585} = \$1,517,674,000.
 \end{aligned}$$

V_1 is greater than V_o because, under full valuation assessment, "old" commercial property would be subject to a lower property tax rate. Currently, the effective rate of tax on property in this category is

$$\frac{T_o}{V_o} = \frac{\$135,740,000}{1,279,000,000} = .10613.$$

And under full-value assessment it would be .06585.

The behavior implicit in our "steady state" method estimates is that assessors and investors capitalize the income from the property employing for this purpose the appropriate discount rate plus the property tax rate derived from the ratio of required revenues (the current property tax levied) to the aggregate value of taxable property.

Finally, "steady state" tax liabilities, T_1 , are calculated by applying the overall effective rate, .06585 in our case, to the "steady state" market values V_1 . For "old" commercial properties

$$\begin{aligned}
 T_1 &= V_1 t_1, \\
 &= \$1,518,000,000 (.06585), \\
 &= \$99,960,000.
 \end{aligned}$$

While it is our judgment that 15 percent is the appropriate capitalization rate for commercial and residential property (see table 9.17), table 9.18 has estimates based on a capitalization rate of 10 percent.

The "steady state" estimates are not very sensitive to the capitalization rate assumed. With the higher rate (15 percent) value changes are somewhat more moderate and tax changes a little sharper than with the lower (10 percent) one.

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Value Property Tax Assessments of Boston Real Estate," prepared for the Boston Urban Observatory in August 1974. With the observatory's generous permission we have included in this essay, substantially unchanged, some parts of the earlier study.

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